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## RECORDS OF REVISION

| Rev. | Date | Description | POC | OIC |
|---|---|---|---|---|
| 0 | 06/29/99 | Document rewritten and reformatted to support LIR 220-03-01, Facility Engineering Manual. This chapter supersedes LANL Facility Engineering Standards Drafting Manual, Vol. 2, Rev. 7, dated 4/17/98. | Danny Nguyen, *PM-2* | Dennis McLain, *FWO-FE* |
| 1 | 10/29/01 | Symbols - generated & on-line; Civil – expanded; Structural – slight modification; Architectural, Mechanical, Electrical - expanded greatly; Mechanical and Electrical - also refer to LEM new examples. | Richard Trout, *FWO-SEM* | Mitch S. Harris, *FWO-SEM* |
| 2 | 07/15/02 | Add new subsections (7.0 & 8.0) on Record Floor Plans. Correct Layering Table. Minor editorial changes as indicated by revision bars. | Richard Trout, *FWO-SEM* | Kurt Beckman, *FWO-SEM* |

# 301 SYMBOLS

## 1.0 WHERE TO USE SYMBOLS

*Guidance: Standard symbols should be used on all drawings, whenever possible. The use of symbols can reduce the drawing time and clarify the drawings by the elimination of unnecessary details.*

## 2.0 SIZE OF SYMBOLS

*Guidance: Symbol sizes can vary according to their use on drawings made "to scale" or "not to scale." The size of symbols on drawings "not to scale" is dependent upon the complexity and aesthetics of the drawings.*

## 3.0 SYMBOL TYPES

*Guidance: The LANL Drafting Manual library graphic symbols found in the Table of Contents are not intended to be a complete listing of all possible symbols required for a project. Symbols may be created if not available in the Drafting Manual graphic symbol library or in industry standard symbols.*

Identify symbols generated that are not in the LANL Drafting Manual library on the discipline legend with a (NS) "non standard" located to the right of the symbol description.

# 302 CIVIL DRAWINGS

## 1.0 DRAWING DESIGN PREPARATION

A. Draw to scale and show north arrow symbol. Show dimensions including elevations in feet and decimals of a foot.

B. Include in the site plan existing features such as buildings, roads, walks, parking areas, large trees, underground and overhead utilities, valve boxes, water meters, fire hydrants, pressure reducing valves, backflow preventers, thrust blocks, valve pits, and other features pertinent to the specific project.

C. Refer to the mechanical drawings for lift stations, sumps, valves, etc. Include in the civil drawings site utilities outside building perimeters. *Electrical/communications site plans may be separated from the utilities plans providing they are carefully coordinated.*

D. Prepare the site plan from a current survey tied to known survey markers located in accordance with the New Mexico State Plan Coordinate System (NMSPC), central zone, and mean sea level elevations. Make the scale is 1 inch equals 20 feet. Include in the plan information necessary for layout of all elements of the new project.

E. Include in the plans, or separate drawing, existing and new features including final contours at appropriate intervals; spot elevations; finish grades for drainage; site improvements; plan and profile of roads, walks, and drainage structures; test hole boring locations; and log data (if available).

F. Include in the landscape and/or terrain management plan a plan of arrangement, list of a plant material, fences, signs, erosion control, irrigation systems, berms, furniture, screens, gravel areas, lights, and other landscape features and structures.

G. Show if a plan and profile drawing sheet are prepared for a utility plan for existing and new utility systems in the area surrounding the project at a scale of 1 inch equals 20 feet. Prepare a plan and profile for new underground utility systems showing invert elevations and cover over the systems shown. *Adjustments to the scale are allowed to avoid excessive sheets and match lines.*

H. Prepare design profiles for: sanitary sewers, storm drains, steam and condensate lines, roadways, and other facilities as required.

I. Prepare profiles or cross-sections for locations where new underground utility runs cross other existing utilities. Show new utility lines as continuous in profile with break lines provided to show changes in direction. Stationing for gravity sewers, storm drains and drainage channels shall progress down gradient. Progress stationing from left to right on the drawing.

J. Reproduce the soil boring logs and required notes on the drawings per Standard Engineering practice.

## 2.0 GRADING AND SITE PLANS

Include the following:

A. Existing structural/utilities include structural number, type, size, and locations from survey information.

B. Manhole invert and rim elevations for existing sewers, storm drains, electrical manholes, etc.

C. New construction, items to be removed, and limits of work.

D. Clearing and grubbing areas.

E. Grading and paving existing contours, finished contours and spot elevations.

F. Stationing, NMSPC coordinates or bearings and distances for location of facilities.

G. Boring test holes and logs where applicable.

H. Cross sections where major grading work is involved.

I. Erosion control measures and type Storm Water Pollution Prevention Plan (SWPP).

J. Match lines of adjacent drawings.

K. Fencing (standard or security).

L. Pedestrian/vehicle circulation patterns, parking layout, striping.

M. Location map.

N. Traffic control/signals/signs.

O. Stockpile and borrow areas

P. Temporary laydown areas for the contractor's equipment

Q. Security fence locations for "Bubbled Out" (space left blank for security purposes) areas.

## 3.0 LANDSCAPING PLANS

Include the following:

A. Planting/irrigation.

B. Recreational layouts.

C. Visual screening.

D. Plant species and size.

## 4.0 UTILITY PLOT PLANS

Include the following:

A. Location of facilities (no contours required).

B. Location of all utilities and describe them as to size, type material and indicate fittings.

C. Proposed points of intersections of all utilities crossings for interference.

D. Depth of cover for utilities.

E. Details.

## 5.0 ROAD PLANS

Include the following:

A. Geometric plan and profile, pavement markings, thickness, cross section, and traffic control devices.

B. Operational plan for vehicular circulation is required showing turnaround movements, ingress and egress.

C. Centerline location, coordinates, or bearing and distances.

D. Stationing.

E. Curve data (show delta (D), radius (R), tangent (T), length (L), point of curvature (PC), point of intersections (PI), and point of tangency (PT).

F. PC and PT stationing.

G. PI coordinates.

H. Typical section.

I. Culverts, ditches, and hillside interceptor benches and slopes.

J. Utility crossings.

K. Parameters of horizontal alignment.

## 6.0 ROAD PROFILES

Include the following:

A. Ground line (existing grade at centerline road).

B. Finished grade (top of finished surface at centerline).

C. Left and right curb profiles (if required).

D. Grades in percentages.

E. Elevations at stations and vertical curve: vertical point of curvature (VPC), vertical point of intersection (VPI), and vertical point of tangency (VPT).

F. Elevations along vertical curve (if required).

G. Parameters of vertical alignment.

H. Culverts & utilities crossing roads.

## 7.0 ROAD CROSS SECTIONS (LOOKING DOWNSTATION)

Include the following:

A. Station, location, and scales.

B. Centerline location.

C. Existing ground line (phantom line type).

D. Finished roadway surface and bottom of base course.

E. Show cut and fill lines and slopes.

## 8.0 STORM DRAIN PLANS

Include the following:

A. Sub-structures size and location. (To be relocated or removed.)

B. Existing storm drains.

C. Existing sewers.

D. New storm drain location (Street or Coordinates and Bearings), stationing, curve data (show D, R, T, L, PC, PI and PT), manholes and transition structures, and junction structure.

E. Catch basin location. (Tie to curb returns or centerline road), type, size, top of invert).

F. Pipe length, size, type, and end inverts.

G. Utilities crossings - water, sewer, gas, oil.

H. Trench conditions.

## 9.0 STORM DRAIN (PROFILE)

Include the following:

A. Ground line (existing grade over storm drain).

B. Street names and stations.

C. Sub-structures (utilities) including crossings sizes, interferences, and elevations.

D. Stationing of beginning and end of sheet (match lines), manholes, structures, and grade changes.

E. Storm drain slope (ft/ft), top and bottom elevations (ft), length and D-load of pipe or strength, box size, station, size, and direction of connecting pipe inlets, and transition structures.

F. Parallel existing storm drains.

G. Parallel existing sewers.

H. Blankets and encasement for sewers.

I. Details of crossings with existing utilities.

## 10.0 SANITARY SEWER PLANS

Include the following:

A. Substructures (existing utilities), size, and location.

B. New sewer location (street or coordinates and bearings), stationing, curve data (show D, R, T, L, PL, PI and PT), manholes (type and all callouts from standard drawings), and sizes.

C. Encasement of sewer.

D. Curbs, driveways, and sidewalks to be removed and replaced.

E. Fire hydrants, valves, or meters to be relocated.

## 11.0 SANITARY SEWER PROFILES

Include the following:

A. Existing ground line and proposed grade over centerline of sewer.

B. Substructures (utilities) crossing size, type, top and bottom elevations - (excavated and checked, if required).

C. Stationing of beginning and end of sheet (match lines), manholes, structures, and grade changes.

D. Sewer profile slope and elevations, (ft/ft) and (ft), length and type of pipe, station size and direction of connecting inlets or Y branches.

E. Parallel existing sewers.

F. Parallel existing storm drains.

G. Encasement for sewers.

H. Details of crossings with existing utilities.

## 12.0 WATER SUPPLY AND DISTRIBUTION

Include the following:

A. Location of all structures and facilities.

B. Location, size and type of domestic water lines, valves, valve pits, meters, etc.

C. Location, size and type of fire water lines, hydrants, post indicator valves, PRV's, sectional (gate) valves, valve boxes, meters, and pits.

D. Coordinates at all angle points of distribution lines.

E. Bearing and distance between PI's.

F. Show utilities and structures along alignment.

G. Show invert elevations at all crossings - both utilities.

H. Calculations for alignment.

I. Typical trench sections and bedding.

J. Thrust blocks location and calculations.

K. Curve data, if required, D, R, T, L, PL, PI and PT.

L. Plan and profile if required; use applicable portions of sewers.

## 13.0 RADIOACTIVE LIQUID WASTE, CAUSTIC, ACID AND CHEMICAL PLANS, AND PROFILES

Include the following:

A. Existing ground line and proposed grade over the piping.

B. Substructures (utilities) crossing size, type, tope and bottom elevations (excavated and checked, if required).

C. Stationing of beginning and end of sheet (match lines), manholes, structures, monitoring stations and grade changes.

D. Piping profile slope and elevations, (ft/ft) and (ft), length and type of pipe, size, station size, and direction of connecting inlets or Y branches.

E. Monitoring system instrument and control

F. Location of control valves, type, model number, and access requirements.

## 14.0 CIVIL SYMBOLS

See Appendix C of the LANL Drafting Manual.

# 303 STRUCTURAL DRAWINGS

## 1.0 DESIGNATION OF COLUMN LINES

On the Plot Plan and Foundation Drawings, locate structures by coordinates. The location of the coordinates shall be the intersection of the column lines in the northeast corner of the structure, where practical.

## 2.0 STRUCTURAL STEEL FRAMING DRAWINGS

Framing Plans and Framing Elevations are schematic drawings. Show the centerlines of steel framing members as solid heavy lines stopping short of the member they frame into. Only show partial outlines of webs, flanges, and legs of members when necessary for clarity.

Example:

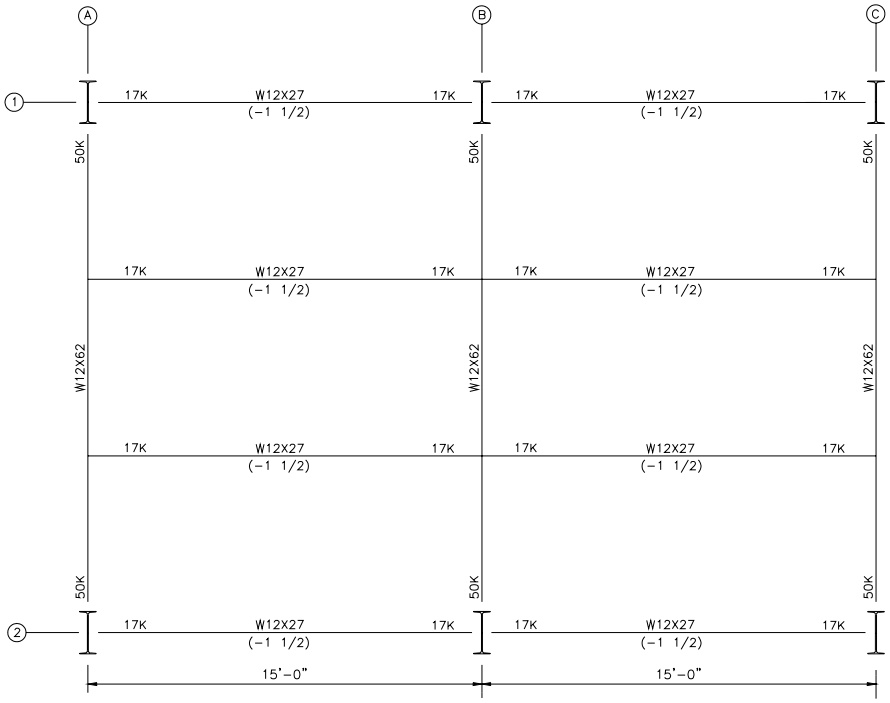


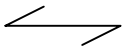
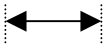

*Figure 303-2*

## 3.0 STRUCTURAL STEEL SHAPES

Label structural steel construction, per AISC M013, “Detailing for Steel Construction."

## 4.0 REINFORCED CONCRETE

Symbols commonly used on reinforced concrete drawings are:

| | |
|---|---|
| # | To indicate size of deformed bar (superscript) |
| Ø | Plain rounds, e.g., spirals (superscript) |
| @ | Spacing center to center |
|  | Direction in which bars extend |
|  | Limits of area covered by bars |

## 5.0 STRUCTURAL DRAWINGS

### 5.1 Dimensioning

On plan views, dimensions are to be tied into points that can readily be transferred to concrete, steel, and other drawings including plot plans. Clearly indicate match lines and centerlines of columns and equipment. When possible, keep dimensions outside the equipment and details. Dimension drawings in feet and inches.

### 5.2 Elevations

A. Indicate elevations in decimals of a foot, e.g., EL 96.25. Indicate elevations on Superstructure Concrete and Steel Drawings in feet and inches, e.g., EL 115' - 6-1/2"

B. Indicate floor and platform elevations to top of steel. Reference floor plate, top of grating or top of slab as + or **-** elevation to top of steel.

C. Generally, the high point of the ground floor slab is to be the main vertical reference line.

### 5.3 Coordinates

On the Plot Plan and Foundation Drawing, locate structures by 2 sets of coordinates. The location of the coordinates shall be the intersection of the column lines and/or at corners of the structure, where practical.

### 5.4 Loads and Reactions

A. Indicate the design loads for principal equipment supported on the drawings in their respective locations.

B. Note Foundation Drawings with “Max Foundation Pressure = _____ lbs/sq. ft." Piling Drawings shall be noted with "Max Pile Load = _____ lbs/pile."

C. Show floor and roof live loadings as well as wind and seismic design basis for future reference and for floor loading postings.

# 6.0 REINFORCED CONCRETE DRAWINGS

## 6.1 General

In general, the drafting practices shown in the ACI 315, "Details and Detailing of Concrete Reinforcement," published by the American Concrete Institute are acceptable.

## 6.2 Reinforcing

A. Space reinforcing bars to the nearest inch, preferably, but in no case shall they be spaced closer than the nearest quarter-inch. *Call-out of bars should be in one view where practical.*

B. Note bar spacing in inches, and inch marks are not to be used, e.g., #6 @ 18.

C. Note bending details on the "Bending Schedule for Reinforcing Steel" where job requirements call for detailing the reinforcing. Show and identify bars cut in a section.

# 7.0 STRUCTURAL STEEL DRAWINGS

## 7.1 General

A. The drawings prepared by the designer shall convey the information necessary for the preparation of erection and shop drawings by the steel fabricator.

B. Indicate the type of construction, types of beams and columns, and all necessary data on loads, shears, moments, and axial forces to be resisted by all members and their connections on drawings.

## 7.2 Connection Guidance

A. *Projects should be shop welded and field bolted where possible.*

B. *Holes for field connections should be 1/16" larger in diameter than bolt. Holes in structural steel to match equipment hole locations should be made 3/16" larger in diameter than connecting bolts. Holes for anchor bolts in column base plates should be 5/16" larger in diameter than the bolt for 3/4" and 7/8" bolts and 1/2" larger for bolts 1" and over.*

## 7.3 Welding

A. Make welding details and notes clear and complete. Provide the size, type, length, and spacing. Draw standard symbols and notations in accordance with the American Welding Society's standards.

B. *A note of caution is given here with respect to welding to vessels which may be stress relieved before shipment to field. No field-welded connections will be allowed, and any connections that are to be made to such vessels must be done by the vessel fabricator.*

# 304 ARCHITECTURAL DRAWINGS

## 1.0 DRAWING PREPARATION

A. Draw building "plan" drawings at a minimum of 1/8" = 1' - 0" scale and preferably at 1/4" = 1' - 0" scale oriented as previously noted in this manual with a north arrow shown.

B. Express drawing dimensions in feet and inches.

C. Draw building elevations in the same scale as the building plan drawings.

D. Note main floor as 100' - 0" elevation on plan.

E. Draw plans in accordance with all approved applicable codes, NFPA and Factory Mutual.

F. Where plans involve the addition to or modification of an existing structure, field verify the existing structure plans and note as "As-Built" or "As-Found" with corresponding building information included.

## 2.0 FOUNDATION PLANS

Include the following:

A. The foundation/building perimeter profile.

B. Column lines.

C. Location and profile of all slab/finish floor elevation changes.

D. Hidden line indicating inside and outside of footing (as applicable).

E. Hidden line indicating the thickness of monolithic slab turndowns (as applicable).

F. Location of all piping sleeves.

G. Building section cut symbols.

H. Detail or detail section symbols.

I. Plumbing fixturing and dimensions to centerline.

J. Locations of all inserts duct trays, recessed electrical receptacles or other specialty items to be inserted into floor concrete.

K. Dimensions.

L. Exterior foundation perimeter.

M. Locations of all offsets.

N. Locations of all slab/floor depressions.

O. Expansion joints.

## 3.0 FLOOR PLANS

Include the following:

A. Perimeter walls drawn to scale.

B. Column lines and exterior building columns.

C. Interior walls drawn to scale.

D. Plumbing fixturing and center lines.

E. Fixed in place partition walls (i.e., restroom partitions).

F. Locations of windows (width) drawn to scale.

G. Locations of doors with handing, size (width) and type of movement drawn to scale.

H. Building section cut symbols.

I. Detail section cut symbols.

J. Enlarged plan or elevation identification symbol.

K. Wall, interior elevation, detail symbols.

L. Room numbers and names.

M. Cabinetry locations, length and width drawn to scale.

N. Mechanical, electrical, plumbing and fire protection equipment locations and rooms shown.

O. Detail, elevation and section symbols shown drawn as per the requirements of this manual.

P. Areas of enlarged plan shall be circled and referenced.

Q. Finished floor elevation.

R. Finished ceiling elevations.

S. Dimensions.

T. Overall building with building additions to include existing building.

U. Building offsets.

V. Interior fixtures not dimensioned elsewhere.

W. Sleeves in cast-in-place concrete walls.

## 4.0 BUILDING ELEVATIONS

Include the following:

A. Approximate final grade line.

B. Foundation extents identified by hidden line below grade line.

C. All attributes of building elevations drawn to scale with window and doors having swings identified.

D. Building section cut symbols.

E. Detail section cut symbols.

F. Enlarged plan or elevation area symbols.

G. Each floor elevation and roof bearing elevation shall be identified as well as any changes within a floor line with a 0.050 broken line.

H. All associated architectural features shall be shown that are relevant to the structure, i.e., finish changes, architectural finish features like inset stucco bands or tile, parapet coping exterior stairs (below grade shown as hidden lines) or free standing entry canopies.

I. Expansion joints both building and finish. Stucco expansion joints shall be in conformance with the stucco manufacturer requirements.

J. Building elevation dimensions.

K. Floor to floor elevations.

L. Floor to finish ceiling.

M. Floor to roof bearing-primary or lowest point.

N. Overall finished first floor to top of roof or roof parapet or mechanical parapet.

O. Grade to first floor.

P. First floor to bottom of lower level (as applicable).

Q. Grade to bottom of footing or turndown.

R. Independent features-length and width-marked for general notes by numerical symbol.

S. Overall length.

T. Any special features, i.e., overhangs and insets.

U. Notations.

V. Materials and types.

W. Special identifications.

## 5.0 BUILDING SECTIONS

Include the following:

A. Drawn to scale minimum of 1/4" = 1' 0" preferably 3/8" = 1' 0"

B. All sectioned architectural building systems and large components shown.

C. All background architectural elevation features shown (interior elements).

D. Primary systems materials section symbols shown.

E. Vertical dimensions.

F. Foundation to floor dimensions.

G. Floor to floor dimensions.

H. Floor system thickness.

I. Primary bearing heights.

J. Elements not vertically dimensioned elsewhere.

K. Notations & Symbols.

L. System or component call-outs.

M. Circled and referenced to enlarged detail as required.

## 6.0 ENLARGED DETAILS AND PLANS

Include the following:

A. More detailed information that cannot be accommodated on a smaller scaled drawing.

B. Materials or components sectioned to show materials symbolically.

C. Components shown sized and located to scale.

D. Background components or features.

E. All materials and components are to be noted and, where applicable, notations shall include height above grade as in plan view.

# 7.0 FLOOR PLAN OF RECORD (FPR)

## 7.1 General Guidance

A. *Floor Plans of Record are used as a baseline priority drawing for Facility Management, Space Planning, Space Management, Emergency Response, Emergency Evacuation Plans, Interior Design, As-Built Record Floor Plans, and Information drawings for outside Architects/Engineers for the development of construction drawings to existing facilities, geo-spatial information for Geographic Information Systems, and Title II design. (See §101.D, "General Definitions")*

## 7.2 Floor Plans of Record Scenarios

A. New building, FPR needed

1. Base the FPR on the As-Built drawings developed by the contractor. If no As-Built drawings are available, then the new building must be field validated to an "as-found" condition.

B. Addition or Modification to Existing Building with a FPR:

**Note**: This includes all modifications to buildings including structure, room, and wall configuration, and door and window removal/relocation.

1. Field-validate all building additions or remodels to confirm actual configuration. The existing FPR along with the as-built modification drawings should be used as the basis for this field validation.
2. Then, generate the RFP revision in accordance with drafting standards defined in §103, "Drawing Revisions" of this manual (including revision note in Title Block giving description of changes).

C. Existing building with As-Built drawing only – Convert to FPR

1. Field validate (walkdown) the existing configuration of the building with as-built as basis. Develop an As-Found Floor Plan of Record based upon that field validation and in accordance with the requirements of §103, "Drawing Revisions" of this manual.
2. In the title block revision field, note that the FPR is "based on as-found conditions as of [date]."

D. Existing building without As-Builts or FPR

1. Field validate (walkdown) the existing configuration of the building and develop a FPR.

## 7.3 Verification of Accuracy -- New and Existing Buildings

A. Submit all FPRs for review and verification for accuracy to the LANL FWO-Info Management Space Tracking and Reporting System team and or representative prior to final acceptance or final signoff of new FPR or revision to an existing FPR.

B. Any revision to a FPR shall be documented by an approved change control procedure.

## 7.4 Priority Drawings

A. FPRs are considered Priority Drawings; note as such on the drawing.

## 7.5 Format

A. Draw all elements of a FPR at a full scale in model space. Insert the standard LANL Title Block sheet into paper space as a block (Layout tab) with the lower left hand corner placed at 0,0.

B. Draw to the standard scales of per this manual. A plan may be drawn to a scale of 1/2" = 1'-0" and labeled as an enlarged floor plan for small buildings where the standard scale would not show details properly (e.g., guard stations). The appropriate scale shall be noted with a bar scale and under the plan title. The LANL Engineering Manual, Chapter 4, Architectural, provides a sample drawing (A-1000 - A-1001, "Floor Plan of Record").

C. Draw no more than one floor plan per sheet. If a floor plan is too large to be placed in the required space the plan must be broken with the use of a "match line." This process must be completed in layout (paper) space so the original building plan does not get broken or segmented.

D. Give drawing dimensions in feet and inches (3'-0" not 3') and follow the LANL dimension style as shown in §209 of this manual.

E. Sheet numbering shall be as follows: The first sheet of the first floor of an FPR shall be numbered A-1000; if there is more than one sheet per floor, then that sheet is to be assigned the next consecutive number after the preceding sheet (A-1001) and so on. The first sheet of the second floor shall be assigned the next consecutive number after the last sheet used on the preceding floor. In the case of each floor having only one sheet, the numbering would be as follows: A-1000 (1st floor), A-1001 (2nd floor), A-1002 (3rd floor), etc. The first sheet of the roof plan shall be the next consecutively numbered sheet after the top floor of the building.

F. A Room Information chart shall be created and positioned as shown on sample drawings A-1000 - A-1001. The chart shall itemize room numbers and room square footage. A data summary shall appear below the chart depicting gross and total measurements and building area.

G. Room square footage shall be measured per FWO-IIM procedures (typically ANSI/BOMA current edition).

## 7.6 Required Plan Elements

1. Exterior and Interior wall construction type, thickness, and room number
2. Retaining walls and thickness attached to building
3. Columns and column center lines (Grid lines and numbers)
4. Permanent walls (rooms, hallways, corridors and vestibules) with room numbers
5. Doors and door swing

6. Windows – operable configuration addressed per keyed notes
7. Wall openings that allow passage from one room to another and start at the floor line
8. Stairways and attached handrails (include stair room number)
9. Utility chases
10. Exterior wall louvers
11. Pads at exterior door (concrete and wood)
12. Interior and exterior ramps. Show direction of slope.
13. Attached docks and canopies
14. Ladders – both interior and exterior
15. Elevators and elevator numbers
16. Built-in millwork and attached equipment
17. Floor pits and numbers
18. Toilet room partitions and fixtures (plumbing etc.)
19. Overall building dimensions, wall thickness, and outside landing/dock dimensions
20. Mezzanines and room numbers
21. Fire wall location and identified with symbols per Appendix D-1 and D-2 (Fire Protection symbols)

**7.7 Use the following layering scheme in FPRs:**

| LAYERING TABLE FOR RECORD FLOOR PLANS | | | | |
|---|---|---|---|---|
| **LAYER NAME** | **LAYER DESCRIPTION** | **LINE STYLE** | **COLOR / #** | **LINE WEIGHT** |
| 0 | Layer used to import drawings and assign new FPR's layers | Cont. | White/7 | 0.35 mm |
| A-COLS | Building columns | Cont. | Light Gray/9 | 0.25 mm |
| A-CUTLINE | Sheet border cut line | Cont. | Dark Gray/8 | 018 mm |
| A-DIM | All building dimensions | Cont. | Arrowheads - Gray/9<br>Text - White/7 | 0.35 mm |
| A-DOOR | All doors and door swings | Cont. | Red/1 | 0.25 mm |
| A-EXCONC. | Loading docks, door landings and sidewalks | Cont. | Red/1 | 0.25 mm |
| A-NOTES | All plan notes and room information chart. | Cont. | White/7 | 0.35 mm |
| A-SCALE | Graphic scale and scale text, plan title, and north arrow | Cont. | White/7 | 0.50 mm |
| A-GRID | Grid line and grid bubble with text | CenterX 2 | Light Gray/9 | 0.25 mm |
| A-AREA-PATT | Hatching | Cont. | Light Gray/9 | 0.25 mm |
| A-TX-RM NBR | Room number and box | Cont. | White/7 | 0.25 mm |

| LAYERING TABLE FOR RECORD FLOOR PLANS | | | | |
|---|---|---|---|---|
| **LAYER NAME** | **LAYER DESCRIPTION** | **LINE STYLE** | **COLOR / #** | **LINE WEIGHT** |
| A-TX-SQ.FT. | Pline square footage text for room/area | Cont. | White/7 | 0.25 mm |
| A-WALL – EXTERIOR | Exterior building walls and attached retaining walls. | Cont. | Cyan/4 | 0.50 mm |
| A-WALL – INTERIOR | Interior walls and partitions | Cont. | Green/3 | 0.50 mm |
| A-GLAZ | Windows and wall louvers | Cont. | Red/1 | 0.55 mm |
| A-PLMB | Toilet partitions and plumbing fixtures | Cont. | Dark Blue/5 | 0.35 mm |
| A-MLWK | Built-in cabinets and counters | Cont. | Mauve/11 | 0.025 mm |
| ROOF | All roof elements, text, and dimensions | Cont. | White/7 | 0.35 mm |
| A-WALL-FIRE | Firewalls | [1] | White/7 | 0.35 mm |
| A-STAIR | Stairs, railings | Cont. | Red/1 | 0.50 mm |
| A-ELEV | Elevators | Cont. | Red/1 | 0.50 mm |

[1] Use symbols from NFPA 170, §5-3.3.1

## 8.0 ROOF PLAN OF RECORD

### 8.1 General Guidance

A. *Roof Plans are useful for security, lightning protection plans, and various other operations and maintenance needs.*

B. *Produce Roof Plans of Record in a manner similar to FPRs above.*

### 8.2 Sheet Numbering

A. The first sheet of the roof plan shall be the next consecutively numbered sheet after the top floor of the building.

### 8.3 Required Plan Elements

1. Overall dimensions
2. Roof type (construction type)
3. Slope
4. Pitch
5. Drain locations
6. Access locations and types (roof hatch, ladder)
7. Overhang with dimension
8. Penetrations and type (plumbing, HVAC, etc.)
9. Penthouses

10. Parapet walls

## 9.0 ARCHITECTURAL SYMBOLS

A. *Symbols used in the AIA Architectural Graphic Standard (AGS) are of such a large number it would be impractical for LANL to create an architectural symbol library and place them on-line. Therefore, the LANL Symbol Library located on the World Wide Web does not address architectural symbols.*

B. Use the current edition of the Architectural Graphic Standards for:

1. Materials in Large scale section and Graphic representation.
2. Materials in Small scale Plan Views and Graphic representation.
3. Surfaces at Small scale and Graphic representation.
4. Surfaces at Large scale and Graphic representation.

# 305 MECHANICAL DRAWINGS

## 1.0 MECHANICAL DRAWINGS

Mechanical Drawings are to include plans, elevations, sections, details, and equipment schedules/lists to clearly define the mechanical requirements of the project.

A. For symbols used in Plans, Sections, Elevations, Details, and Isometrics, use the standard mechanical symbols found in the LANL Symbol Library in Appendices E1 to E3.

B. Use double-line piping in highly congested areas as necessary to clarify the construction.

C. Use double-line ductwork, except where not permitted by Project Engineer. Show diffusers, grilles, and registers with sizes, flow rates and directions of flow noted on the drawings or in a schedule. Indicate all thermostats/sensors, duct mounted controls, control panels, etc., on the ductwork drawings.

D. Place fire protection piping drawings on separate sheets and do not include with other piping system drawings, except as may be specifically permitted by Project Engineer.

E. Include control diagrams and sequence of operations in the mechanical drawing set, if requested by the client.

F. Individual large scale mechanical equipment room plan and sections as well as mechanical details shall fully detail the design.

G. Draw mechanical equipment to scale with required maintenance and tube removal spaces outlined. Ensure that the equipment can be installed and/or removed without having to dismantle or remove other equipment or permanent construction.

H. Indicate the outline of electrical equipment, including working space clearance, on the mechanical drawings (equipment room, plans, etc.) to ensure that the mechanical equipment does not interfere with the electrical equipment working space as required by the NEC. Do not locate mechanical equipment/piping (i.e., water piping, ductwork, pumps, etc.) above switchboards, panel boards, and motor control centers. Consult with the electrical section designer for the applicable code clearance requirements.

I. Isometrics (riser diagrams) (as a minimum requirement) shall be prepared for the following systems:

- Potable/non-potable water
- Sanitary waste/vent
- Radioactive liquid waste/vent
- Process liquid waste

## 2.0 PROCESS FLOW DIAGRAMS (PFDS) & PIPING & INSTRUMENT DIAGRAMS (P&IDS)

A. For engineering requirements pertaining to P&ID diagrams, refer to the LANL Engineering Manual, Chapter 6, Section 310.

B. Refer to the PFD/P&ID Drafting Symbol Library, Appendix G1-G3 of this manual, for drafting symbols to be used in PFD, P&ID, and I&C drawings.

C. On PFDs and P&IDs indicate (at a minimum) the items as defined in the LANL Engineering Manual, Chapter 6, Section 310. Text to be 1/8" high, color white (7), 0.35 mm (0.015") thick.

D. *P&IDs may extend beyond the drafting field (refer to LANL Drafting Manual requirements Section 202 Drawing Title Blocks, 3.0.g) for clarity purposes only.*

E. Do not cross control runs. Break secondary signals, not the process line.

F. Make flow arrows 1/4 inch.

G. Process Flow Diagram and P&ID Layering Convention modified for LANL use from UDS:

| LAYER NAME | DESCRIPTION | COLOR | LINE WIDTH |
|---|---|---|---|
| MI-PC | Main and/or Primary instrument supply or process | 13-14 | 0.70 mm (0.030") |
| MI-SE | Secondary Systems = Bypasses | 1-4 | 0.50 mm (0.02") |
| MI-SY | Symbol inserted from the symbol or created on the sheet, plan breaks, continuation flags | 7 | 0.35 mm (0.015") |
| MI-TX | Text typed or inserted | 7 | 0.35 mm (0.015") |
| MI-PS | Pneumatic signals | 5-8 | 0.35 mm (0.015") |
| MI-ES | Electric, electromagnetic, sonic signals | 5-8 | 0.35 mm (0.015") |
| MI-HS | Hydraulic signals | 5-8 | 0.35 mm (0.015") |
| MI-US | Undefined signals | 5-8 | 0.35 mm (0.015") |
| MI-HT | Heat trace | 5-8 | 0.35 mm (0.015") |
| MI-SL | Software or data link, internal system links | 5-8 | 0.35 mm (0.015") |
| MI-EL | Mechanical links | 5-8 | 0.35 mm (0.015") |
| MI-CT | Capillary tube | 5-8 | 0.35 mm (0.015") |
| MI-WB | Wall barrier | 5-8 | 0.35 mm (0.015") |
| MI-EX | Existing equipment, systems, components, lines, text, symbols, etc. | 9 | 0.25 mm (0.010") |
| MI-BL | Buried lines | 9 | 0.25 mm (0.010") |

H. *The system flow should generally be from left to right and from top to bottom.*

I. Draw PFD & P&IDs to a scale of 1:1 but labeled as "scale: none" on the drawing.

J. Draw PFD & P&IDs with a snap of 1/16 inch.

K. *For systems having various parameters of operation it is recommended on PFDs that a "Parameter Chart" be shown. The chart should appear on the bottom of the drawing designated for Keyed Notes and General Notes. Layer Text to be 1/8 inch in height, chart outline and vertical columns to be 0.50 mm, 0.025 mm for horizontal lines. Example of a parameter chart as follows:*

*Condition #1 = maximum allowable working condition; Condition #2 = normal operating condition; Condition #3 = minimal allowable working condition.*

| OPERATING CONDITION | | KEY COMPONENTS | | | |
|---|---|---|---|---|---|
| | | ◇1 | ◇2 | ◇3 | ◇4 |
| CONDITION #1 | FLOW | 20,000 CFM | | | |
| | PRESS | 3.5" $H_2O$ | | | |
| | TEMP | 100°F | | | |
| CONDITION #2 | FLOW | | | | |
| | PRESS | | | | |
| | TEMP | | | | |
| CONDITION #3 | FLOW | | | | |
| | PRESS | | | | |
| | TEMP | | | | |

*Figure 305-1*

L. Use table form, using parameters at identified locations on process lines as "Keyed Notes."

M. *PFDs may also warrant a mass flow/balance table.*

N. For symbols required for a PFD and/or P&ID not found in the General Instrument or Function Symbols legend, refer to ISA 5.1. If a symbol is created for a specific project not found in ISA 5.1, create the symbol, add the symbol to the Symbol Legend, and identify the symbol(s) as "non-standard" (NS).

## 3.0 MECHANICAL EQUIPMENT LIST

A. Example:

| MECHANICAL EQUIPMENT LIST | | | | |
|---|---|---|---|---|
| ITEM NO. | LOCATION RM.NO. | NO. REQ'D. | DESCRIPTION, MANUFACTURER OR APPROVED EQUAL | FURN. BY |
| ◇1 | RM 100 | 1 | PUMP ..... | CONTR |

*Figure 305-2*

B. Provide a mechanical equipment list for projects required by client.

C. Provide an equipment list for each individual discipline set (HVAC, plumbing, fire protection, etc.) and locate the sheet in the discipline drawing set as outlined in Section 211of this manual.

D. Indicate mechanical equipment items by an item number in a diamond. The item numbers shall be in sequence for the entire mechanical drawing set. (See Appendix)

E. Note in the "FURN. BY" column, if the equipment is furnished by the contractor (CONTR) or Government Furnished Equipment (GFE).

## 4.0 MECHANICAL SYMBOLS

A. Use applicable graphics symbols on drawings and include a mechanical legend on the first sheet of the mechanical drawing set. Refer to Appendix D and E.

B. *Pipe fitting symbols are depicted without a joint connection symbols. The joint symbol is optional, however, the symbols should be consistent throughout the entire mechanical drawing set. It is also preferred to note the type of joint (welded, soldered, flanged, etc.) in the specification and not by use of a symbol.*

# 306 ELECTRICAL DRAWINGS

A. Refer to LANL Engineering Manual, Chapter 7, Section D5000 (future), for discussion of development and a typical one-line diagram.

B. Use ST7001, Legend and General Notes, as the starting point for the electrical drawing set legend.

C. Do no use General Notes on projects that include construction specifications.

## 1.0 ONE-LINE DIAGRAMS

A. Use symbols and blocks from the LANL Electrical Symbol Library, Appendix F of this manual.

B. Make text 1/8" high, color white (7), 0.35 mm (0.015 inches) thick. Exceptions:

1. Panel designations (i.e., SWB-A, PP-1, etc.) shall be 3/16 inch, AutoCAD font Romand.
2. Items listed in Section 213.2.G.

C. *One-line diagrams may extend beyond the drafting field (Reference Section 202.3.G) for clarity purposes only.*

D. Existing conditions to be 0.25 mm (0.010 inches) line width, new conditions to be 0.70 mm (0.030 inches) line width.

E. *Avoid crossing circuit runs.*

F. Use conventional Drafting Standards if one-line diagram continues to another sheet.

G. Line type for existing conditions: Phantom for conduit wiring and equipment - dashed for enclosures.

H. Line type for new conditions: Continuous for conduit, wiring and equipment - dashed for enclosures.

I. Organize drawing to be read from top to bottom. Text read horizontally or vertically, read from the right side of the sheet.

J. Data input on separate layers (use AIA CAD layering convention). Refer to Section 212, Basic Line Widths item D, for line weight and type.

EXISTING & NEW
Text
Wiring
Conduit
Enclosures
Equipment

K. Equipment shall be associated with the room number in which it is located.

L. Refer to LANL Engineering Manual, Chapter 7, Section 300, ST7002 for a typical one-line diagram.

## 2.0 ELECTRICAL EQUIPMENT PLANS

A. Show working clearances for all electrical distribution equipment.

B. *Show equipment plans on separate drawings as follows:*

1. *Power Plan*
   - *Major electrical distribution equipment, motors, and major electrical loads*
2. *Receptacle Plan*
   - *Receptacles and circuiting*
   - *Locations of the branch circuit panels*
3. *Lighting Plan*
   - *Lighting fixtures, switches, and circuiting*
   - *Emergency and exit lighting fixtures and circuiting*
   - *Location of the branch circuit panels*
4. *Special Systems Plan*
   - *Telecommunications outlets*
   - *Telecommunications rooms*
   - *Fire Alarm System*
   - *Security equipment*

C. Use standard symbols and blocks in accordance with Appendix F of this manual.

## 3.0 WIRING DIAGRAMS

Refer to LANL Engineering Manual, Chapter 7, Section 300, ST7008 for a typical wiring diagram.

A. Show the connection of an installation or its component devices, controllers', and equipment.

B. A wiring diagram may cover internal or external connections, or both, and shall contain such detail as is needed to make or trace connections that are involved. *It usually shows the general physical arrangement of devices and device elements and also accessory items such as terminal blocks, fuses, power supplies, etc.*

## 4.0 ELECTRICAL SCHEMATICS

A. Requirements: Use standard symbols and blocks in accordance Appendix F of this manual.

B. *Guidance:*

1. *Refer to LANL Engineering Manual, Chapter 7, Section 300, ST7008 for a typical motor schematic.*
2. *Schematic diagrams show, by means of graphic symbols, the electrical connections and functions of a specific circuit arrangement. The schematic diagram facilitates tracing the circuit and its functions without regard to the actual physical size, shape, or location of the component device or parts.*
3. *Schematics are intended to show major components and the flow of electrical power and control.*
4. *Schematics are not intended to show wire sizes or terminations, etc. Refer to LANL Engineering Manual, Chapter 7, Section 300, ST7002 wiring diagram for detail to be shown on a wiring diagram.*

## 5.0 ELECTRICAL SCHEDULES

Refer to LANL Engineering Manual, Chapter 7, Section 200, Figure 247-1 or its successor, for typical electrical schedules.

A. Use standard symbols and blocks in accordance with Appendix F of this manual.